REMARKS

Claims 1-20 are pending in the application. Claims 16 has been amended. Claim 21 has been added. Claims 2, 3, 6, 7, and 20 have been withdrawn from consideration.

In the Office Action, claims 10-15 and 17 were allowed.

Claims 18 and 19 were rejected under 35 U.S.C. §112, first and second paragraphs, because the Examiner contends that the recitations in independent claim 18 of "an F end face" and "end face accuracy is at most 30 μm" are not adequately supported in the specification. Regarding the "end face accuracy" recitation, this rejection is traversed, because the recited end face accuracy, and a method of deriving it, is described in exacting detail at page 35, lines 22-32 of the present application. The recited end face accuracy is described such that one skilled in the art would have been able to make the claimed invention. Therefore, this limitation of claim 18 meets the requirements of §112, first and second paragraphs.

Regarding the "F end face" recitation, an English-language version of the relevant portion of the Japanese Industrial Standards (JIS), discussed at page 35, lines 19-21 of the present application, is submitted herewith. This is a published English-language document, published by the Japanese Standards Association and available at the time the invention was made and the application was filed, which shows that "F end face" is a standard and definite term in the U.S. Therefore, this limitation of claim 18 meets the requirements of §112, first and second paragraphs.

Consequently, the rejection of claims 18 and 19 under §112 should be withdrawn.

Claims 1, 5 and 18-19 have been rejected under 35 U.S.C. § 102 as being anticipated by Japanese Patent Document 5-272529 (Japan). Regarding independent claims 1 and 5, Japan does

not disclose the recited cage comprising a pocket with a roller holding portion having a length between 30% and 80% of a radial length of the pocket. Referring to Fig. 1 of Japan, a holder 4 (i.e., a cage) retains roller bearings 3, while orbit rings 1 and 2 rotate relative to each other (see, Japan, English Abstract) along with case 5 and case 6, respectively. There is no teaching or suggestion in Japan of the recited roller holding portion having a length between 30% and 80% of a radial length of a pocket. Details of holder 3 are not shown or described in detail. Therefore, the Examiner has no basis for contending that the recited roller holding portion is disclosed by Japan.

Japan does not anticipate claim 1 or 5, since it does not disclose each and every element of those claims. Moreover, it would not have been obvious to modify Japan to yield the claimed invention. Japan does not teach or suggest the technical concept of adjusting the length of the roller holding portion, while taking into consideration the trade-off between improvement of oil flow and roller-holding functionality. Therefore, optimization of the length of the roller holding portion, as claimed, would not have been obvious to one skilled in the art reading Japan.

Consequently, claims 1 and 5 are patentable.

Regarding the anticipation of independent claim 18 based on Japan, this reference does not disclose or even suggest the recited end face or end face accuracy of this claim. Japan does not anticipate claim 18, since it does not disclose each and every element of that claim. Moreover, Japan does not disclose or even suggest the technical concept of optimizing the shape of the end face and improving end face accuracy to suppress drilling abrasion and to lower bearing noise, as discussed in the present application. Therefore, it would not have been obvious to modify Japan to include the recited end face or end face accuracy.

Consequently, claim 18 is patentable, as is claim 19, which depends from claim 18.

Claim 16 has been rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent 6,431,761 (Yamaguchi). This claim has been amended to recite that the upper member and the lower member are superposed on each other at inner and outer radial portions of their respective holding portions, such that respective radially extending surfaces of the holding portions contact each other. Claim 16 has been further amended to recite that the upper member and the lower member are caulked at the inner and outer radial portions of their respective holding portions, such that an end portion of one of the upper and lower members surrounds a first face, an end face and a second face of an end portion of the other of the upper and lower members. In other words, the upper and lower members are caulked such that the end portion of one member is bent and comes in contact with three faces of the end portion of the other member. These amendments are supported, for example, at Figs. 2A-2C and the corresponding description in the present application (*see*, e.g., page 16, lines 9-27 of the present application).

According to the invention of amended claim 16, radially opposed portions of the holding portions of the upper and lower members are less likely to block the passage of oil, thereby improving oil passage to the inside of the bearing. In addition, since the upper and lower members are firmly fastened to one another, the possibility of separation of the upper and lower members during operation of the bearing is decreased.

Yamaguchi does not disclose or even suggest the newly recited features of amendment claim 16. Therefore, Yamaguchi does not anticipate amended claim 16, and it would not have been obvious to modify Yamaguchi to yield the invention of amended claim 16.

Consequently, claim 16 is patentable.

Claims 4, 8, and 9 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Japan as set forth in the rejection of claims 1, 5, and 18-19, and in further view of British Patent 444,292 (GB). Claim 4 has been further rejected under 35 U.S.C. §103 as being obvious over Japan in view of the common knowledge in the art or, in the alternative, engineering design choice. GB does not furnish the features of independent claims 1 and 5, from which claims 4, 8 and 9 depend, of a cage comprising a pocket with a roller holding portion having a length between 30% and 80% of a radial length of the pocket, missing from Japan. Therefore, any combination of Japan and GB, however made, would still be missing this important claimed feature, and it would not have been obvious to add this feature to any Japan/GB combination to yield the invention of claims 4, 8 or 9. Likewise, common knowledge in the art does not furnish the features of independent claim 1, from which claim 4 depends, of a cage comprising a pocket with a roller holding portion having a length between 30% and 80% of a radial length of the pocket, missing from Japan. Therefore, it would not have been obvious to add this feature to Japan based on common knowledge in the art to yield the invention of claim 4.

Consequently, claims 4, 8 and 9 are patentable.

New claim 21 has been added reciting, ***inter alia***, a cage for holding a roller having a hardened case, wherein an upper member and lower member of the cage are superposed on each other at inner and outer radial portions of respective roller holding portions such that respective radially extending surfaces of the holding portions contact each other, and the upper member and the lower member are spot-welded to each other. This claim is supported, for example, at Figs. 8A-8C and the corresponding description at page 24, line 24 et seq. New claim 21 reads on the elected species. It is the same as amended claim 16 except for the recitation of fastening of the upper and lower members being by spot welding rather than by caulking.

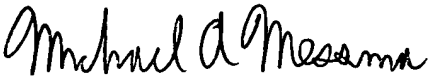
According to the invention of new claim 21, radially opposed portions of the holding portions of the upper and lower members are less likely to block the passage of oil, thereby improving oil passage to the inside of the bearing. In addition, the upper and lower members are firmly fastened to one another using a simplified fastening method, which ensures sufficient fastening strength while reducing manufacturing cost.

Accordingly, it is believed that all pending claims are now in condition for allowance. Applicants therefore respectfully request an early and favorable reconsideration and allowance of this application. If there are any outstanding issues which might be resolved by an interview or an Examiner's amendment, the Examiner is invited to call Applicants' representative at the telephone number shown below.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

McDERMOTT WILL & EMERY LLP



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JIS

JAPANESE INDUSTRIAL STANDARD

Rollers for roller bearings

JIS B 1506–1991

Translated and Published

by

Japanese Standards Association

In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

UDC 621.822.81

JAPANESE INDUSTRIAL STANDARD

Rollers for roller bearings

J I S
B 1506-1991

1. Scope

This Japanese Industrial Standard specifies needle rollers, long cylindrical rollers and cylindrical rollers (hereafter referred to as the "rollers") to be used mainly as rolling elements of rolling bearings.

Remarks 1. The tapered rollers and convex rollers are in accordance with Annex 1.

2. Applicable Standards to this Standard are the following:

JIS B 0104-Rolling Bearings – Vocabulary

JIS B 0401-System of Limits and Fits

JIS B 0651-Instruments for the Measurement of Surface Roughness by the Stylus Method

JIS B 1515-Measuring Methods for Rolling Bearings

JIS G 4805-High Carbon Chromium Bearing Steels

JIS Z 2244-Method of Vickers Hardness Test

JIS Z 2245-Method of Rockwell and Rockwell Superficial Hardness Test

JIS Z 2251-Method of Micro Hardness Test for Vickers and Knoop Hardness

ISO 683-17-1976 Heat-treated steels, alloy steels and free-cutting steels—Part 17 : Ball and roller bearing steels

2. Definitions and quantity symbols

Definitions and quantity symbols of main terms used in this Standard are in accordance with the following.

Further, for definitions other than these are in accordance with JIS B 0104.

(1) designation The designation to be used for indicating that the diameter and length of roller are generally the same.

(2) nominal diameter (D_w) The value of diameter of roller to be used for indicating that the diameter of roller is generally the same.

(3) single diameter (D_{ws}) In a plane vertical to the central axis of roller (radial plane), the distance between the two straight lines parallel to each other contacting the actual surface of the roller.

(4) mean diameter in plane (D_{wmp}) The arithmetical mean value of the maximum value and the minimum value of single diameter of roller in a radial plane.

(5) diameter variation in a single radial plane ($V_{D_{wp}}$) The difference between the maximum value and the minimum value of single diameter of roller in a radial plane.

(6) single plane mean diameter variation ($V_{D_{wmp}}$) The difference between the maximum value and the minimum value in mean diameter in plane of a roller.

(7) nominal length (L_w) The value of length to be used for indicating that the length of roller is generally the same.

(8) actual length (L_{ws}) The distance between two radial planes including the actual end of roller.

Reference Standards:

JIS B 1511-General Code for Rolling Bearings

ISO 3096 Needle roller bearings—Needle rollers—Dimensions—Metric series

ISO 6193 Rolling bearings—Needle rollers—Tolerances

(9) dimension difference of length (ΔL_{ws}) The difference between the actual length and the nominal length.

(10) actual chamfer dimension (r_s) The actual radial distance or axial distance in an axial plane from the imaginary corner of roller of plane shape of end plane up to the intersecting point of chamfer of roller and the end surface or rolling contact surface.

(11) smallest permissible single chamfer dimension of roller ($r_{s\ min}$) The smallest permissible radial single chamfer dimension and axial single chamfer dimension of roller.

(12) largest permissible single chamfer dimension of roller ($r_{s\ max}$) The largest permissible radial single chamfer dimension and axial single chamfer dimension of roller.

(13) roller end surface runout with outside surface (S_w) The deviation of roller end surface relative to radial plane of roller.

(14) deviation from circular form (ΔR) The largest radial distance between the smallest circle circumscribed to the line of intersection of one radial plane and the rolling contact surface and each point on the line of intersection.

(15) gauge The range of dimensional differences of diameters determined by upper and lower permissible dimensional deviations of mean diameter in plane (D_{wmp}) in radial plane passing the middle of length of roller from the nominal diameter (D_w).

Remarks: The gauge is to be indicated by upper and lower permissible dimensional difference expressed by the unit of micrometer for example as – 2/– 4.

(16) gauge lot A group of rollers same in grade and nominal dimension, having the mean diameter in plane (D_{wmp}) existing in the same gauge in all.

(17) gauge lot diameter variation ($^{V}D_{wL}$) The difference of mean diameters in plane of the largest roller and the smallest roller in mean diameter in plane (D_{wmp}).

(18) gauge lot length variation ($^{V}L_{wL}$) The difference between the actual lengths of the largest roller and the smallest roller in actual length (L_{ws}) in a certain gauge lot.

3. Classification and division

Roller shall be classified into needle roller, long cylindrical roller and cylindrical roller and, divided, as a rule, according to Table 1.

Table 1. Classification and division

Classification	Division	
	D_w	L_w / D_w
Needle roller	5 mm max.	3 min. and 10 max.
Long cylindrical roller	Exceeding 5 mm	3 min. and 10 max.
Cylindrical roller	——	Less than 3

4. Grades

The grades of rollers shall be as given in Table 2.

Table 2. Grade

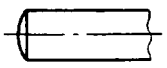
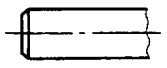
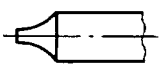
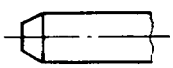
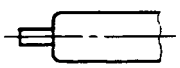
Classification	Grades
Needle roller	2, 3, 5
Long cylindrical roller	3, 5
Cylindrical roller	1, 1 A, 2, 2 A, 3, 5

5. Designation, dimensions and roller end surface shape

The designation, and dimensions shall be as given in Attached Tables 1 to 3. The roller end surface shapes and symbols shall be as given in Table 3. Provided that the end surface of cylindrical roller shall be plane shape.

Remarks: Dimensions of end surface shapes of sharp type, conical type and stepped type are not specified.

Table 3. Roller end surface shapes and symbols

	Round surface shape	Plane surface shape(1)	Sharp shape	Conical shape	Stepped shape
Roller end surface shape					
Symbol	A	F	C	T	M

Note (1) It includes that having a recess at the central part of roller end surface.

6. Quality

6.1 Dimensions, shape and roller end surface runout with outside surface The deviation from circular form, dimensional difference of length of roller, diameter variation in a single radial plane of needle roller, single plane mean diameter variation of long cylindrical roller and cylindrical roller as well as roller end surface runout with outside surface of cylindrical roller shall be as given in Attached Tables 4 to 6.

6.2 Gauge lot diameter and length variations The gauge lot diameter variation of roller shall be as given in Attached Tables 4 to 6. The gauge lot length variation of cylindrical roller shall be as given in Attached Table 6.

6.3 Single chamfer dimensions The permissible limit value of single chamfer dimensions of needle rollers having plane shape in end surface shape shall be as given in Attached Table 7. The permissible limit value of single chamfer dimensions of long cylindrical roller and cylindrical roller shall be as given in Attached Table 8.

6.4 Hardness The hardness of roller shall be as given in Attached Table 9.

6.5 Surface roughness of rolling contact surface The surface roughness of rolling contact surface of roller shall be as given in Table 4.

Table 4. Surface roughness of rolling contact surface (largest)

D_w (mm)	5 max.	Exceeding 5 up to and including 18	Exceeding 18 up to and including 50	Exceeding 50
Surface roughness (Ra)	0.1 a	0.2 a	0.4 a	0.8 a

7. Materials

Materials of roller shall be those of JIS G 4805, ISO 683-17 or those equivalent or superior thereto.

8. Measuring method and testing method

8.1 General matters General matters relating to measuring shall be as specified in JIS B 1515.

8.2 Single diameter The measuring of single diameter (D_{ws}) of roller shall be carried out in the radial plane according to two-point measurement.

The mean diameter in plane (D_{wmp}) of roller shall be obtained in a radial plane as the arithmetical mean value of the maximum value and the minimum value of single diameter.

8.3 Diameter variation in a single radial plane The diameter variation in a single radial plane ($^{V}D_{wp}$) of needle roller shall be obtained in the radial plane at the middle of length as the difference between the maximum value and the minimum value of single diameter (D_{ws}).

8.4 Deviation from circular form The measurement of deviation from circular form (ΔR) of roller shall, as a rule, be carried out by using a circularity measuring device at the radial plane of the middle of length of roller. The deviation from circular form shall be obtained as the maximum value of distance in radial direction from the minimum circumscribed circle to the line of intersection of this radial plane and the rolling contact surface of roller to each point on the line of intersection.

Further, the deviation from circular form may be obtained according to two-point measurement and three-point measurement (Refer to Annex 2).

8.5 Single plane mean diameter variation The single plane mean diameter variations ($^{V}D_{wmp}$) of long cylindrical roller and cylindrical roller shall be obtained as the difference between the maximum value and the minimum value out of the mean diameters in plane (D_{wmp}) in radial planes at three portions of the middle of roller length and the cylindrical parts near both ends.

8.6 Gauge lot diameter variation and gauge The gauge lot diameter variation ($^{V}D_{WL}$) of roller shall be obtained as the mean diameter in plane of the maximum roller and the minimum roller in the mean diameter in plane (D_{wmp}) in the radial plane at the middle of length in the gauge lot.

The gauge of roller shall be obtained in the radial plane passing the middle of length of roller as the corresponding gauge out of the recommended gauges in Attached Tables 4 to 6 in dimensional difference between the mean diameter in plane (D_{wmp}) of gauge lot and the nominal diameter (D_w).

8.7 Dimension difference of length and gauge lot length variation The measurement of actual length (L_{ws}) of roller shall, as a rule, be carried out between the plane and plane shape gauge head parallel thereto.

The dimension difference (ΔL_{ws}) of length of roller shall be obtained as the difference between the actual length and the nominal length (L_w).

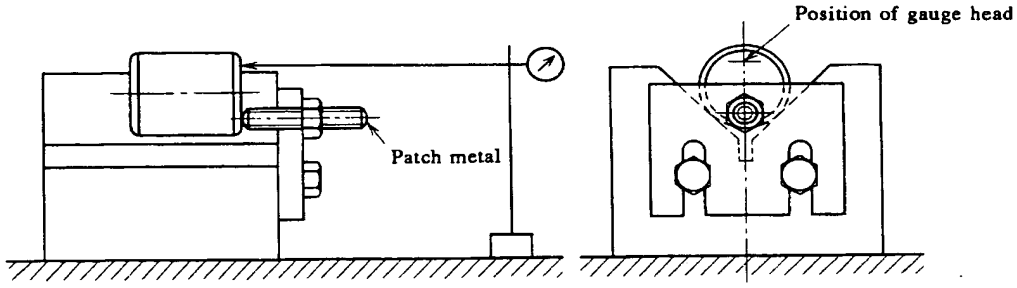
The gauge lot length variation ($^{V}L_{WL}$) of cylindrical roller shall be obtained as the actual length difference of the maximum roller and the minimum roller in actual length in the gauge lot.

8.8 Roller end surface runout with outside surface For the roller end surface runout with outside surface (S_w) of cylindrical roller, as a rule, place the roller at the V groove, contact in spot the portion near the periphery of one end surface with the patch metal and apply the gauge head to the symmetrical position to the central axis of roller at the contact point at the end surface, rotate the roller and carry out the measurement (Refer to Fig. 1).

Obtain the roller end surface runout with outside surface as the difference between the maximum value and the minimum value of readings of measuring device when rotating the roller once.

Further, carry out this measurement relating to both end surfaces.

Fig. 1. Measuring of roller end surface runout with outside surface



8.9 Single chamfer dimension The measurement of chamfer dimensions of plane shape roller in end surface shape shall be carried out by using a suitable measuring device.

8.10 Hardness The hardness test shall be in accordance with JIS Z 2251, JIS Z 2244 or JIS Z 2245.

8.11 Surface roughness of rolling contact surface The measurement of surface roughness of rolling contact surface shall be in accordance with JIS B 0651.

9. Inspection

The inspection of the roller shall be carried out relating to dimensions, shape, roller end surface runout with outside surface, gauge lot diameter variation and length variation, single chamfer dimensions, hardness, and surface roughness of rolling contact surface, according to 8. and, comply with the specifications of 6.1 to 6.5.

10. Designation of products

Rollers shall be designated by classification, nomenclature, end surface shape([2]), gauge and grade.

Examples	(1)	Needle roller	2 × 11.8 A	– 3/– 6	Grade 3
	(2)	Log cylindrical roller	6 × 50 F	– 5/– 10	Grade 5
	(3)	Cylindrical roller	15 × 22	– 2/– 4	Grade 2

Note ([2]) It does not apply to cylindrical rollers.

11. Packaging and marking

11.1 Packaging Rollers, after performing rust prevention by fats and oils, and others, shall be stored in a suitable container.

11.2 Marking The package of rollers shall be marked with the following matters:

(1) Classification

(2) Designation

(3) End surface shape (excluding the cylindrical roller.)

(4) Gauge

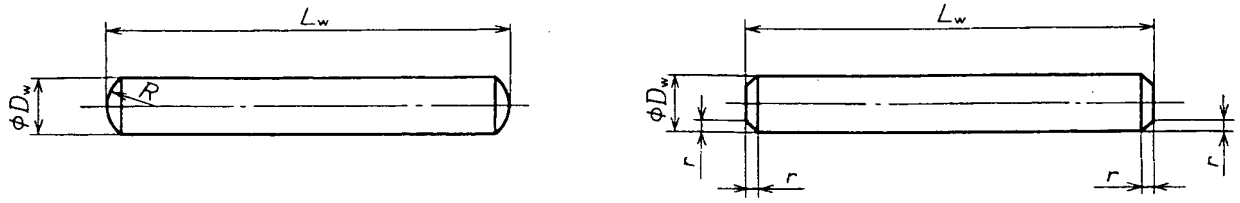
(5) Grade

(6) Quantity

(7) Manufacturer's name or its mark

(8) Year and month of manufacture or the mark

Attached Table 1. Designation and dimensions of needle roller



Unit: mm

Designation	D_w	L_w	$r_{s\,min}$ (3)	Designation	D_w	L_w	$r_{s\,min}$ (3)
1 × 5.8	1	5.8	0.1	3.5×19.8	3.5	19.8	0.1
1 × 6.8	1	6.8	0.1	3.5×21.8	3.5	21.8	0.1
1 × 7.8	1	7.8	0.1	3.5×23.8	3.5	23.8	0.1
1 × 9.8	1	9.8	0.1	3.5×25.8	3.5	25.8	0.1
1.5× 5.8	1.5	5.8	0.1	3.5×27.8	3.5	27.8	0.1
1.5× 6.8	1.5	6.8	0.1	3.5×29.8	3.5	29.8	0.1
1.5× 7.8	1.5	7.8	0.1	3.5×31.8	3.5	31.8	0.1
1.5× 9.8	1.5	9.8	0.1	3.5×34.8	3.5	34.8	0.1
1.5×11.8	1.5	11.8	0.1	4 ×13.8	4	13.8	0.1
1.5×13.8	1.5	13.8	0.1	4 ×15.8	4	15.8	0.1
2 × 6.8	2	6.8	0.1	4 ×17.8	4	17.8	0.1
2 × 7.8	2	7.8	0.1	4 ×19.8	4	19.8	0.1
2 × 9.8	2	9.8	0.1	4 ×21.8	4	21.8	0.1
2 ×11.8	2	11.8	0.1	4 ×23.8	4	23.8	0.1
2 ×13.8	2	13.8	0.1	4 ×25.8	4	25.8	0.1
2 ×15.8	2	15.8	0.1	4 ×27.8	4	27.8	0.1
2 ×17.8	2	17.8	0.1	4 ×29.8	4	29.8	0.1
2 ×19.8	2	19.8	0.1	4 ×31.8	4	31.8	0.1
2.5× 7.8	2.5	7.8	0.1	4 ×34.8	4	34.8	0.1
2.5× 9.8	2.5	9.8	0.1	4 ×37.8	4	37.8	0.1
2.5×11.8	2.5	11.8	0.1	4 ×39.8	4	39.8	0.1
2.5×13.8	2.5	13.8	0.1	4.5×17.8	4.5	17.8	0.1
2.5×15.8	2.5	15.8	0.1	4.5×19.8	4.5	19.8	0.1
2.5×17.8	2.5	17.8	0.1	4.5×21.8	4.5	21.8	0.1
2.5×19.8	2.5	19.8	0.1	4.5×23.8	4.5	23.8	0.1
2.5×21.8	2.5	21.8	0.1	4.5×25.8	4.5	25.8	0.1
2.5×23.8	2.5	23.8	0.1	4.5×29.8	4.5	29.8	0.1
3 × 9.8	3	9.8	0.1	4.5×31.8	4.5	31.8	0.1
3 ×11.8	3	11.8	0.1	4.5×34.8	4.5	34.8	0.1
3 ×13.8	3	13.8	0.1	4.5×37.8	4.5	37.8	0.1
3 ×15.8	3	15.8	0.1	4.5×39.8	4.5	39.8	0.1
3 ×17.8	3	17.8	0.1	5 ×19.8	5	19.8	0.1
3 ×19.8	3	19.8	0.1	5 ×21.8	5	21.8	0.1
3 ×21.8	3	21.8	0.1	5 ×23.8	5	23.8	0.1
3 ×23.8	3	23.8	0.1	5 ×25.8	5	25.8	0.1
3 ×25.8	3	25.8	0.1	5 ×27.8	5	27.8	0.1
3 ×27.8	3	27.8	0.1	5 ×29.8	5	29.8	0.1
3 ×29.8	3	29.8	0.1	5 ×31.8	5	31.8	0.1
3.5×11.8	3.5	11.8	0.1	5 ×34.8	5	34.8	0.1
3.5×13.8	3.5	13.8	0.1	5 ×37.8	5	37.8	0.1
3.5×15.8	3.5	15.8	0.1	5 ×39.8	5	39.8	0.1
3.5×17.8	3.5	17.8	0.1	5 ×49.8	5	49.8	0.1

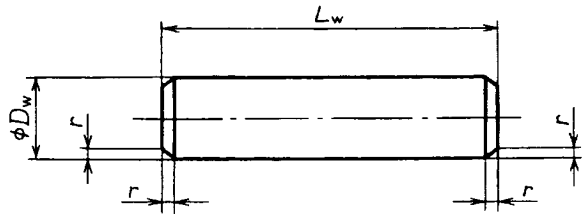
Note (3) It is the minimum permissible single chamfer dimension, and applies to roller of plane shape in end surface shape.

Remarks 1. The figure indicates that of round surface shape and plane shape in end surface shape.

2. The minimum dimension of radius R of roundness of end surface of round surface shape in end surface shape is to be $\frac{D_w}{2}$ and the maximum dimension is to be $\frac{L_w}{2}$.

3. Attached Table 1 indicates the recommended designations and dimensions.

Attached Table 2. Designation and dimensions of long cylindrical roller



Unit: mm

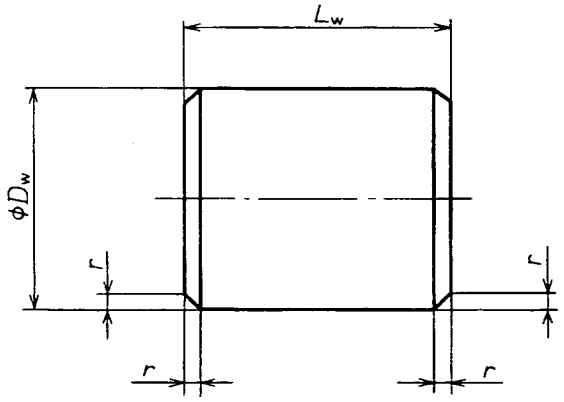
Designation	D_w	L_w	$r_{s\,min}$ (3)	Designation	D_w	L_w	$r_{s\,min}$ (3)
5.5×18	5.5	18	0.2	8 ×50	8	50	0.3
5.5×22.4	5.5	22.4	0.2	8 ×63	8	63	0.3
5.5×28	5.5	28	0.2	9 ×28	9	28	0.3
6 ×20	6	20	0.2	9 ×35.3	9	35.5	0.3
6 ×25	6	25	0.2	9 ×45	9	45	0.3
6 ×31.5	6	31.5	0.2	9 ×56	9	56	0.3
6 ×40	6	40	0.2	10 ×31.5	10	31.5	0.3
6 ×50	6	50	0.2	10 ×40	10	40	0.3
6.5×20	6.5	20	0.3	10 ×50	10	50	0.3
6.5×25	6.5	25	0.3	10 ×63	10	63	0.3
6.5×31.5	6.5	31.5	0.3	12 ×40	12	40	0.3
7 ×22.4	7	22.4	0.3	12 ×50	12	50	0.3
7 ×28	7	28	0.3	12 ×63	12	63	0.3
7 ×35.5	7	35.5	0.3	15 ×45	15	45	0.5
7 ×45	7	45	0.3	15 ×56	15	56	0.5
7 ×56	7	56	0.3	15 ×71	15	71	0.5
7.5×31.5	7.5	31.5	0.3	15 ×90	15	90	0.5
7.5×40	7.5	40	0.3				
8 ×25	8	25	0.3				
8 ×31.5	8	31.5	0.3				
8 ×40	8	40	0.3				

Note (3) It is the minimum permissible single chamfer dimension, and applies to roller of plane shape in end surface shape.

Remarks 1. The figure indicates the roller of plane shape in end surface shape.

2. Attached Table 2 indicates the recommended designations and dimensions.

Attached Table 3. Designation and dimensions of cylindrical roller



Attached Table 3 (Continued)

Unit: mm

Designation	D_w	L_w	$r_{s\,min}$ (4)	Designation	D_w	L_w	$r_{s\,min}$ (4)
3 × 3	3	3	0.1	19×19	19	19	0.6
3 × 5	3	5	0.1	19×28	19	28	0.6
3.5× 5	3.5	5	0.2	20×20	20	20	0.6
4 × 4	4	4	0.2	20×30	20	30	0.6
4 × 6	4	6	0.2	21×21	21	21	0.6
4 × 8	4	8	0.2	21×30	21	30	0.6
4.5× 4.5	4.5	4.5	0.2	22×22	22	22	0.6
4.5× 6	4.5	6	0.2	22×34	22	34	0.6
5 × 5	5	5	0.2	23×23	23	23	0.6
5 × 8	5	8	0.2	23×34	23	34	0.6
5 ×10	5	10	0.2	24×24	24	24	0.6
5.5× 5.5	5.5	5.5	0.2	24×36	24	36	0.6
5.5× 8	5.5	8	0.2	25×25	25	25	0.7
6 × 6	6	6	0.2	25×36	25	36	0.7
6 × 8	6	8	0.2	26×26	26	26	0.7
6 ×12	6	12	0.2	26×40	26	40	0.7
6.5× 6.5	6.5	6.5	0.3	28×28	28	28	0.7
6.5× 9	6.5	9	0.3	28×44	28	44	0.7
7 × 7	7	7	0.3	30×30	30	30	0.7
7 ×10	7	10	0.3	30×48	30	48	0.7
7 ×14	7	14	0.3	32×32	32	32	1
7.5× 7.5	7.5	7.5	0.3	32×52	32	52	1
7.5×11	7.5	11	0.3	34×34	34	34	1
8 × 8	8	8	0.3	34×55	34	55	1
8 ×12	8	12	0.3	36×36	36	36	1
9 × 9	9	9	0.3	36×58	36	58	1
9 ×14	9	14	0.3	38×38	38	38	1
10 ×10	10	10	0.3	38×62	38	62	1
10 ×14	10	14	0.3	40×40	40	40	1
11 ×11	11	11	0.3	40×65	40	65	1
11 ×15	11	15	0.3	42×42	42	42	1
12 ×12	12	12	0.3	45×45	45	45	1
12 ×18	12	18	0.3	48×48	48	48	1
13 ×13	13	13	0.3	50×50	50	50	1
13 ×20	13	20	0.3	52×52	52	52	1.5
14 ×14	14	14	0.3	54×54	54	54	1.5
14 ×20	14	20	0.3	56×56	56	56	1.5
15 ×15	15	15	0.5	60×60	60	60	1.5
15 ×22	15	22	0.5	64×64	64	64	1.5
16 ×16	16	16	0.5	68×68	68	68	1.5
16 ×24	16	24	0.5	75×75	75	75	2
17 ×17	17	17	0.5	80×80	80	80	2
17 ×24	17	24	0.5				
18 ×18	18	18	0.5				
18 ×26	18	26	0.5				

Note (4) It indicates the minimum permissible single chamfer dimensions.
Remarks: Attached Table 3 indicates the recommended designations and dimensions.

Attached Table 4. Permissible deviations, permissible values and recommended gauges of dimensions and shapes of needle rollers

Unit: μm

Grade	Diameter variation from circular form(5) $V_{D_{wp}}$ (max.)	Deviation from circular form(5) ΔR (max.)	Gauge lot diameter variation(5) $V_{D_{WL}}$ (max.)	Dimension difference of length(6) ΔL_{ws}	Recommended gauge
2	1	1	2	h13	0/−2, −1/−3, −2/−4, −3/−5, −4/−6, −5/−7, −6/−8, −7/−9, −8/−10
3	1.5	1.5	3	h13	0/−3, −1.5/−4.5, −3/−6, −4.5/−7.5, −6/−9, −7/−10
5	2	2.5	5	h13	0/−5, −3/−8, −5/−10

Notes (5) It applies to the middle of roller length.

(6) It is in accordance with division of L_w.

Remarks: Every single diameter over all the lengths of rollers shall not be larger by exceeding the following value than the actual maximum diameter at the middle of roller length:

Relating to Grade 2 0.5 μm

Relating to Grade 3 0.8 μm

Relating to Grade 5 1 μm

Attached Table 5. Permissible deviations, permissible values and recommended gauges of dimensions and shapes of long cylindrical rollers

Unit: μm

Grade	Deviation from circular form(5) ΔR (max.)	Single plane mean diameter variation(7) $V_{D_{wmp}}$ (max.)	Gauge lot diameter variation(5) $V_{D_{WL}}$ (max.)	Dimension difference of length(6) ΔL_{ws}	Recommended gauge
3	1.5	3	3	h12	+4.5/ +1.5, +3 / 0, +1.5/ −1.5, 0 / −3, −1.5/ −4.5, −3 / −6, −4.5/ −7.5, −6 / −9, −7.5/−10.5, −9 /−12, −10.5/−13.5, −12.5/−15, −13.5/−16.5, −15 /−18, −16.5/−19.5
5	2	5	5	h12	+5 / 0, +2.5/ −2.5, 0 / −5, −2.5/ −7.5, −5 /−10, −7.5/−12.5, −10 /−15, −12.5/−17.5, −15 /−20, −17.5/−22.5, −20 /−25

Notes (5) It applies to the middle of roller length.

(6) It is in accordance with division of L_w.

(7) It applies to the cylindrical part of outside diameter surface.

Attached Table 6. Permissible deviations, permissible values and recommended gauges of dimensions and shapes of cylindrical rollers

Unit: μm

Grade	D_w (mm)		Deviation from circular form[5] ΔR	Single plane mean diameter variation[7] $V_{D_{wmp}}$	Gauge lot diameter variation[5] $V_{D_{WL}}$	Dimension difference of length[8] ΔL_{ws}		Gauge lot length variation $V_{L_{WL}}$	Roller end surface runout with outside surface S_w	Recommended gauge
	Min.	Max.	(max.)	(max.)	(max.)	Upper	Lower[9]	(max.)	(max.)	
1	3	18	0.5	0.8	1	+10	−[(IT9) − 10]	5	3	+5/+4, +4.5/+3.5, +4/+3, +3.5/+2.5, +3/+2, +2.5/+1.5, +2/+1, +1.5/+0.5, +1/0, +0.5/−0.5, 0/−1, −0.5/−1.5, −1/−2, −1.5/−2.5, −2/−3, −2.5/−3.5, −3/−4, −3.5/−4.5, −4/−5, −4.5/−5.5, −5/−6, −5.5/−6.5, −6/−7, −6.5/−7.5, −7/−8, −7.5/−8.5, −8/−9, −8.5/−9.5, −9/−10
1A	3	30	0.7	1	1.5	+10	−[(IT9) − 10]	7	5	+5/+3.5, +4.5/+3, +3.5/+2, +3/+1.5, +2/+0.5, +1.5/0, +0.5/−1, 0/−1.5, −1/−2.5, −1.5/−3, −2.5/−4, −3/−4.5, −4/−5.5, −4.5/−6, −5.5/−7, −6/−7.5, −7/−8.5, −7.5/−9, −8.5/−10
2	3	50	1	1.5	2	+10	−[(IT9) − 10]	10	6	+5/+3, +4/+2, +3/+1, +2/0, +1/−1, 0/−2, −1/−3, −2/−4, −3/−5, −4/−6, −5/−7, −6/−8, −7/−9, −8/−10
2A	10	80	1.3	2	2.5	+10	−[(IT9) − 10]	13	8	+5/+2.5, +3.5/+1, +2.5/0, +1/−1.5, 0/−2.5, −1.5/−4, −2.5/−5, −4/−6.5, −5/−7.5, −6.5/−9, −7.5/−10, −9/−11.5, −10/−12.5, −11.5/−14, −12.5/−15, −14/−16.5, −15/−17.5, −16.5/−19, −17.5/−20
3	18	80	1.5	3	3	+10	−[(IT9) − 10]	15	10	+4.5/+1.5, +3/0, +1.5/−1.5, 0/−3, −1.5/−4.5, −3/−6, −4.5/−7.5, −6/−9, −7.5/−10.5, −9/−12, −10.5/−13.5, −12/−15, −13.5/−16.5, −15/−18, −16.5/−19.5
5	30	80	2.5	4	5	+10	−[(IT9) − 10]	25	15	+5/0, +2/−3, 0/−5, −3/−8, −5/−10, −8/−13, −10/−15, −13/−18, −15/−20, −18/−23, −20/−25

Notes ([5]) It applies to the middle of roller length.

([7]) It applies to the cylindrical part of outside diameter surface.

([8]) It indicates the numerical value of basic tolerance of IT 9 according to division of L_w (Refer to JIS B 0401).

([9]) The lower dimension difference is to be the value of basic tolerance to length of respective roller subtracted by 10 μm.

Attached Table 7. Permissible limit values of single chamfer dimensions of needle roller

Unit: mm

D_w		$r_{s\,min}$([10])	$r_{s\,max}$
Exceeding	Max.		
—	1	0.1	0.4
1	3	0.1	0.6
3	5	0.1	0.9

Note ([10]) It is the minimum permissible single chamfer deviation specified in Attached Table 1.

Remarks: It applies to the roller of plane shape in end surface shape.

Attached Table 8. Permissible limit values of single chamfer dimensions of long cylindrical roller and cylindrical roller

Unit: mm

$r_{s\,min}$([11])	$r_{s\,max}$
0.1	0.3
0.2	0.5
0.3	0.8
0.5	1.2
0.6	1.5
0.7	1.7
1	2.2([12])
1.5	3.5
2	4

Notes ([11]) It applies to the minimum permissible single chamfer dimensions specified in Attached Table 2 and Attached Table 3.

([12]) In the case where D_w exceeds 40 mm, $r_{s\,max}$ is to be taken as 2.7 mm.

Remarks: It applies to the roller of plane shape in end surface shape.

Attached Table 9. Hardness

D_w (mm)		Hardness	
Exceeding	Max.	HRC	HV
—	3	(60 to 67)	697 to 900
3	—	58 to 66	(653 to 865)

Remarks 1. The hardness is to be the plane hardness.

2. Values in ( ) indicate the converted values for informative reference.

Annex 1. Tapered rollers and convex rollers

1. Scope

This Annex specifies the tapered rollers and convex rollers (hereafter referred to as the "rollers") used as rolling elements of roller bearings.

Remarks 1. Definitions and quantity symbols are in accordance with Body 2.

2. Hardness and materials shall be, as a rule, in accordance with the specifications of Body 6.4 and 7.

2. Grades

Grades of rollers shall be as given in Annex 1 Table 1.

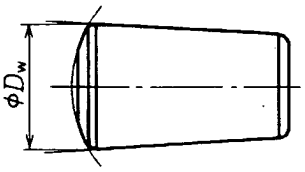
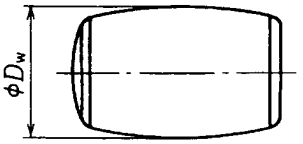
Annex 1 Table 1. Grades

Classification	Grade
Tapered roller	1, 1 A, 2, 2 A, 3, 5
Convex roller	2, 2 A, 3, 5

3. Nominal diameters and shapes

The nominal diameters and the shapes shall be as given in Annex 1 Table 2.

Annex 1 Table 2. Nominal diameters and shapes

Classification	Shape	Remarks
Tapered roller		The diameter of imaginary circle intersected by outside diameter surface and the roller large end face is to be taken as the nominal diameter (D_w).
Convex roller		The largest diameter of outer diameter surface is to be taken as the nominal diameter (D_w).

4. Quality

The deviations from circular form, roller end surface runouts with outside surface and gauge lot diameter variations shall be as given in Annex 1 Table 3.

Annex 1 Table 3. Permissible values of dimensions and shapes

Unit: μm

Grade	D_w (mm)		Deviation from circular form	Gauge lot diameter variation	Roller end surface runout with outside surface
	Min.	Max.	ΔR (max.)	V_{DwL} (max.)	S_w (max.)
1	3	10	1	1	4
1 A	3	18	1	1.5	5
2	3	30	1.5	2	6
2 A	10	50	2	2.5	8
3	10	80	2.5	3	10
5	18	80	4	5	15

5. Measuring method

5.1 Single diameter The measurement of single diameter (D_{ws}) of roller shall, as a rule, be carried out according to two-point measurement in the radial plane.

Further, at a definite position from the roller large end face, it may be carried out with comparing with the master roller (the roller to be reference).

The mean diameter in plane of roller (D_{wmp}) shall be obtained as the arithmetic mean value of the maximum value and the minimum value of single diameters in a radial plane.

5.2 Deviation from circular form The deviation from circular form (ΔR) shall, as a rule, be measured in the radial plane at a definite position from the roller large end face by using a circularity measuring device. The deviation from circular form shall be obtained as the maximum value of distance in radial direction from the minimum circumscribed circle to the line of intersection of this radial plane and the rolling contact surface of roller up to each point on the line of intersection.

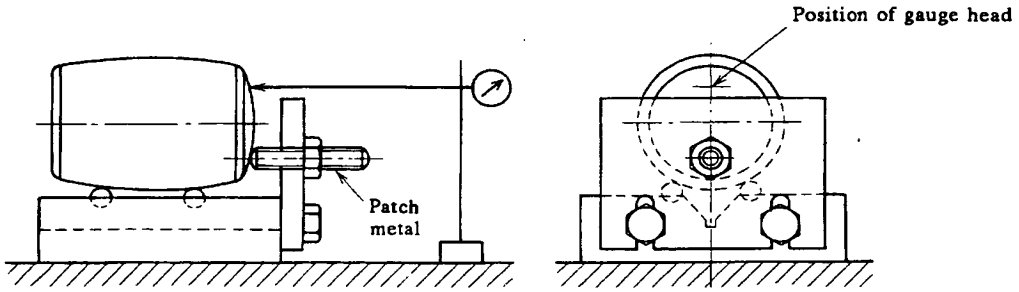
Further, the deviation from circular form may be obtained according to two-point measurement and three-point measurement (Refer to Annex 2).

5.3 Gauge lot diameter variation The gauge lot diameter variation (V_{DwL}) of roller shall be obtained as the difference of mean diameters in plane of the maximum roller and the minimum roller in mean diameter in plane (D_{wmp}) at the specific position from the roller large end face in the gauge lot.

5.4 Roller end surface runout with outside surface For the measurement of end surface runout with outside surface of roller (S_w), as a rule, place the roller on the supporting stand, spot contact with the patch metal at a portion near the periphery of roller large end face, at the end face apply the gauge head to the symmetrical position to the central axis of roller and at the contact point, rotate the roller and carry out the measurement (Refer to Annex 1 Fig. 1).

Obtain the roller end surface runout with outside surface as the difference of the maximum value and the minimum value of readings when rotating the roller once.

Annex 1 Fig. 1. Measurement of roller end surface runout with outside surface



6. Designation of products

Rollers shall be designated according to the classification, basic number of roller bearing, gauge and grade.

Examples (1) Tapered roller 30207 – 2/– 4 Grade 3

(2) Convex roller 22215 – 2/– 4 Grade 5

Annex 2. Measurement of deviation from circular form

1. Measuring by using a circularity measuring device

The measuring by using a circularity measuring device is usually performed by evaluating numerically the circumference of roller recorded on the polar-line diagram indicating the measured circumference. The measured circumference is expressed by enlarging the deviating in radial direction of roller to high magnification. This deviation is recorded while rotating the roller or stylus (gauge head) correctly around the central axis of roller.

The correctness of spindle rotation and the sensitivity of transducer shall be within 0.025 μm. Because it is high magnification in radial direction, for interpretation of polar-line diagram caution is required.

There are several methods to be used usually for finding out the distance in the radial direction of the measured circumference from the true circle.

The minimum circumscribed circle method of one thereof, is comparatively simple and relative to the roller it is a method capable of satisfying approximately.

2. Measuring according to V block

The deviation from circular form is generated from the profile of circumference having two or more undulations (peaks) that is the deviation in radial direction from the complete circle. In the measuring of single diameter at the middle of roller length, in the case of even number undulations (peaks) it indicates the error from the true circle, but in the case of odd number undulations (peaks) it can not find out the error or can not measure correctly in some cases.

In order to measure the error of profile of roller having odd number undulations (peaks) from the true circle, the using of measuring device according to V block arranged as shown in Annex 2 Fig. 1 is practical. The angle of V has remarkable influence to the reading of indicator and there is not an angle suitable for all undulations (peaks).

The most practical angle of V is considered to be 90° and 120°, the reading of indicator and the height of actual undulation (peak) those are the extension coefficients as the ratio to deviation from circular form are shown in Annex 2 Table 1.

The deviation from circular form can be obtained by the reading of indicator divided by this coefficient.

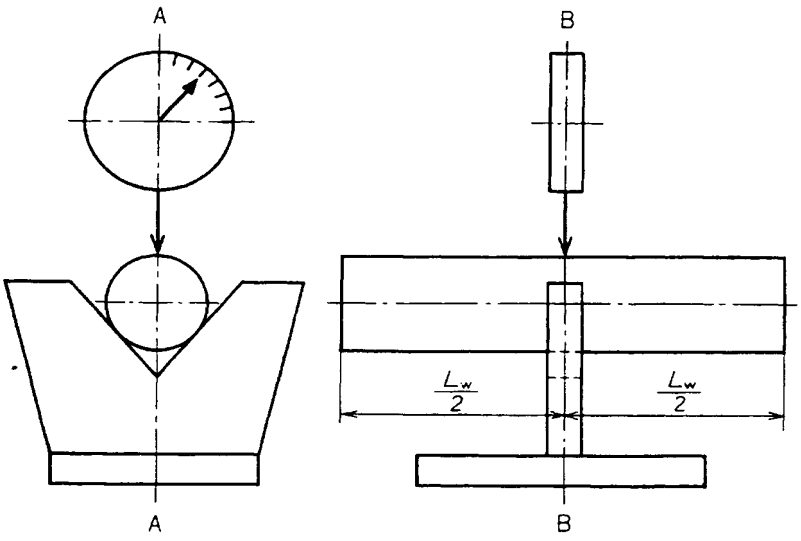
The contacting point of stylus (gauge head) with roller is required to be on the axial line B–B which passes the central line of roller at the middle of roller length and the axial line A–A which is the bisector of V. The spindle of indicator shall be also coincident with axial lines A–A and B–B.

Annex 2 Table 1. Extension Coefficients

Angle of V	Number of undulations (peaks)									
	3	5	7	9	11	13	15	17	19	21
	Extension coefficient									
90°	2	2	—	—	2	2	—	—	2	2
120°	1	2	2	1	—	—	1	2	2	1

Remarks: Extension coefficient = $\frac{\text{reading of indicator}}{\text{deviation from circular form}}$

Annex 2 Fig. 1. Measuring according to V block



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